鈴木三男*：北海道中新世産トウヒ属材化石

Mitsuo SUZUKI*: A fossil wood of *Picea* from the Miocene of Hokkaido

日本の新第三紀中新世のグリーンタフ地域は極めて豊富に植物化石を含んでいる。材化石も例外ではなく，本州日本海側及び岩手県産の材化石は，主に亘理俊次博士により精力的に研究されてきた (Watari 1941, 1952, 1956)。一方，北海道も材化石を多産することが知られているが，報告のほとんどは白亜紀または古第三紀産の材化石についてである (Reiss 1907, Stopes & Fujii 1910, Shimakura 1937, Watari & Nishida 1973, Suzuki 1975)。渡島半島には本州の日本海側のそれと連続するグリーンタフがあり，亘理の報告と同じ種の材化石の出現が予想されるが，筆者の知る限りではそのような報告はない。

筆者が棚井博士より提供を受けた材化石は渡島半島檜山郡上の国村石崎川の上流，中新世初期福山層群の産で，黒褐色に硅化しており，内部構造の保存は極めて良い。記載にあるようにトウヒ属のヒメバラモミ (*Picea maximowiczii* Regel) によく似た材構造を示すことがわかったのでここに報告する。

快く標本を提供してくださった北海道大学棚井敏雅教授に心から謝意を表する。

Picea cf. **maximowiczii** Regel (Figs. 1-5)

Material: No. 22001 is a piece of a fairly large silicified trunk, which was collected by Dr. Toshimasa Tanai. The preservation of its internal structure is fairly excellent. The specimen is deposited in Fossil Plant Collection, College of Liberal Arts, Kanazawa University.

Locality: The upper stream of Ishizaki River, Kaminokuni-mura, Hiyama-gun, Hokkaido.

Horizon: Fukuyama formation, Lower Miocene, Tertiary.

Description: Coniferous wood with vertical and horizontal resin canals. Annual rings distinct, width rather narrow (0.7-2.1 mm). Transition from the early wood to the late wood somewhat gradual. Early-wood tracheids radially elongated rectangular or polygonal in cross section, 30-45 (mean 36.8) μm and 35-60 (mean 48.7) μm in tangential and radial diameters respectively, thin-

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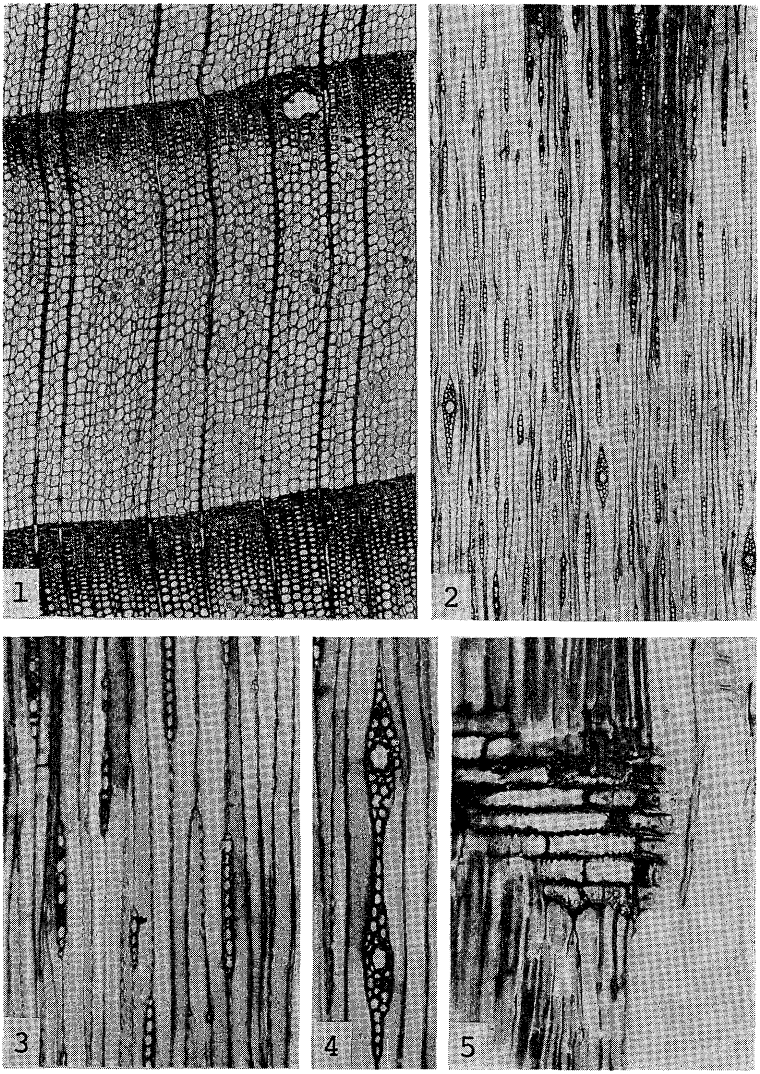

Figs. 1–5. *Picea* cf. *maximowiczii* Regel, No. 22001. 1: Cross section (×40), showing two boundaries of annual rings and a vertical resin canal in the late wood. 2: Tangential section (×40) near the boundary of an annual ring, showing uniseriate and fusiform rays with horizontal resin canals. 3: A further magnification of 2 (×100), showing a horizontal wall of resin cells (left upper side), small bordered pits on tangential walls of tracheids (also left upper side) and spiral thickenings in the early-wood tracheids. 4: Tangential section (×100), showing a united fusiform ray with two resin canals. 5: Radial section (×200), showing spiral thickenings in tracheids at the boundary of annual rings, and a ray, in which horizontal and vertical walls of parenchyma cells are densely pitted and distinct spiral thickenings are shown in ray tracheids.

walled: bordered pits on radial walls uniseriate or biseriate with opposite arrangement, circular or horizontally elongated elliptical with 21.3 μm in mean diameter; spiral thickenings present but often only faintly seen. Late-wood tracheids tangentially flattened rectangular in cross section, 20-40 (mean 28.1) μm and 10-25 (mean 14.9) μm in tangential and radial diameters respectively; fairly thick-walled; bordered pits on radial walls usually uniseriate with fairly wide intervals, circular in outlines, small (9.2 μm in mean diameter); bordered pits on tangential walls at boundary of annual rings scattered, smaller than those on radial walls (7.3 μm in mean diameter); spiral thickenings distinctly seen. Vertical resin canals restricted at the late wood, usually in couple, sometimes solitary or triple, round or tangentially elongated elliptical in cross section, 82.4 μm in mean diameter; coupled or tripled canals arranged tangentially. Resin cells rarely present at boundary of annual rings, rectangular in cross section; horizontal walls densely pitted. Rays consisting of parenchyma cells and tracheids, uniseriate or fusiform; 4-8 rays per mm. Uniseriate rays 1-19, mostly 2-12, cells high; one or two rows of ray tracheids usually at margin of rays. Fusiform rays usually with a horizontal resin canal and rarely with two canals because of fusion of two fusiform rays. Ray parenchyma cells vertically elongated elliptical or oval in tangential section, 14.7 μm and 19.5 μm in tangential and vertical mean diameters respectively; horizontal and vertical walls fairly thick and densely pitted with simple pits (so-called abietineous pitting); pits in a cross field with tracheids 2-5, small and oval in outline with narrow apertures (piceoid). Ray tracheids vertically long and tangentially narrow triangle or rectangle in tangential section; bordered pits on radial and vertical walls fairly smaller than those of vertical tracheids; spiral thickenings fairly distinct. Horizontal resin canals fairly smaller than vertical canals enclosed by 6-9 (mean 7.2) epithelial cells. Crystals invisible in any kinds of cells.

類縁 本化石は垂直・水平の両樹脂道をもつ針葉樹で，春・夏材双方の仮導管と放射仮導管の内壁にらせん肥厚を持つことから，トガサワラ属かトウヒ属のいずれかであることがわかる。前者は後者に較べ，一般に水平樹脂道の分泌細胞の数が4〜6個と少なく，本化石が平均7.2個であることから後者に属することがわかる。トウヒ属の多くの種は仮導管のらせん肥厚を欠くか，若齢部の夏材部にのみ限定されるが，この属の中では原始的と考えられているヒメバラモミなどには存在している (Sudo 1968)。またトウヒ属の多くは年輪界の樹脂細胞を欠くが，ヒメバラモミはそれを有する (Watari 1956) 点も本化石と一致し，本化石がこの種に最も近似した材構造を持っていることが

わかる。しかしヒメバラモミは放射組織や樹脂道の柔細胞に結晶を持っており（Sudo 1968），本化石には結晶が見られない点で異なる。

本州の中新世からは3種のトウヒ属の材化石が知られている。*Picea* cf. *jezoensis* Carr.（Watari 1956）は現生のエゾマツに似た材構造をもったもので山形県から報告された。これは仮導管にらせん肥厚を持たず，本化石とは明らかに異なる。また *Picea wakimizui* (Watari) Watari (1941, 1956) は岩手県から知られ，本化石とは (1) らせん肥厚が夏材部の仮導管に限られる，(2) 年輪界の樹脂細胞を欠く，などにより区別できる。また山形県からは *Picea palaeomaximowiczii* Watari (1956) も知られている。これは現生のヒメバラモミに極めて近い材構造を示すが，結晶を豊富に柔細胞に持つ点で本化石とは異なっている。また北海道空知郡歌志内市の上部白亜紀から，*Piceoxylon transiens* Shimakura (1937) が知られているが，らせん肥厚の出現が偶発的であり，仮導管の有縁壁孔が交互状に配列するなど，本化石とは明確に異なっている。以上のことから，本化石は現生のヒメバラモミに極めて似た材構造をもち，我が国に知られているトウヒ属およびそれに近縁な材化石の種とも異なることが明らかになったので，*Picea* cf. *maximowiczii* Regel として記載した。

ヒメバラモミは現在では本州中部の亜高山帯にわずかしか分布していないが，洪積世にはもっと広い分布をしていたことが知られている。本化石の産出は，現生種に近似した種がさらに広く，北海道にまで分布していたことを示している。

Summary

A piece of a fairly large silicified wood was presented from Dr. Toshimasa Tanai, Hokkaido University, who had found it from the Lower Miocene strata of southern Hokkaido. This fossil is a conifer wood characterized by the presence of both vertical and horizontal resin canals in its normal wood. Its other anatomical features are 1) the pitting of ray cells is the so-called abietineous, 2) spiral thickenings are present not only in the late-wood tracheids but also in the early-wood tracheids, 3) resin cells are rarely present at boundary of annual rings, and 4) cross-field pitting is piceoid. These characteristics and features of the present fossil clearly indicate that the fossil may have an affinity with *Pseudotsuga* or *Picea* of the Pinaceae. However, the wood structure of the former genus differs from the fossil by fewer epithelial cells (usually 4-6 cells) of horizontal resin canals and also by taxodioid cross-field pitting. Therefore the fossil surely belongs to the latter genus, *Picea.* Furthermore, it is also clarified that the fossil has the closest affinity with the

extant species, *Picea maximowiczii* Regel in all of the above-mentioned features, although the fossil slightly differs from the living species by the absence of crystals in ray cells.

Three species of fossil wood belonging to *Picea* are known from the Miocene of Japan. *Picea* cf. *jezoensis* Carr. (Watari 1956) differs clearly from the present fossil by its absence of spiral thickenings in tracheids and by some other features. *P. wakimizui* (Watari) Watari (1941, 1956) also differs from that by the absence of resin cells and spiral thickenings in the early-wood tracheids. *P. palaeomaximowiczii* Watari (1956) shows very close resemblance with the present fossil, but it also differs from the fossil by the abundnt occurrence of crystals in ray parenchyma cells. Therefore, the present fossil is identified as *Picea* cf. *maximowiczii* Regel. This is the first report on the fossil wood from the Miocene of Hokkaido as far as the author noticed.

References

Reiss, K. 1907. Untersuchung über fossile Hölzer aus Japan. Inaug.-Diss. Rostock. Shimakura, M. 1937. Studies on fossil woods from Japan and adjacent lands, contribution II. The Cretaceous woods from Japan, Saghalien and Manchoukuo. Sci. Rep. Tohoku Imp. Univ., 2nd ser. (Geology) **19**: 1-73. Stopes, M. C. & K. Fujii. 1910. Studies on the structure and affinities of cretaceous plants. Phil. Trans. Roy. Soc. London **20B**: 1-91. Sudo, S. 1968. Anatomical studies on the wood of species of *Picea*, with some considerations on their geological distribution and taxonomy. Bull. Gov. Forest Exp. Stat. No. **215**: 39-130. Suzuki, M. 1975. Two new species of nyssaceous fossil woods from the Palaeogene of Japan. Journ. Jap. Bot. **50**: 228-238. Watari, S. 1941. Studies on the fossil woods from the Tertiary of Japan II. Fossil woods from the River Nesori, Namiuti Village, and the River Hiranuka, Kozuya Village, Ninohe District, Iwate Prefecture. Jap. Journ. Bot. **11**: 417-438. ——. 1952. Dicotyledonous woods from the Miocene along the Japan-Sea side of Honsyu. Jour. Fac. Sci. Univ. Tokyo, Sect. III **6**: 97-134. ——. 1956. Some abietinean woods from the Tertiary of Japan. Jour. Fac. Sci. Univ. Tokyo, Sect. III **6**: 419-437. —— & M. Nishida. 1973. A *Juniperoxylon* from the Tertiary of Hokkaido. Journ. Jap. Bot. **48**: 154-159.